

H. Wormald

FEBRUARY, 1916

BULLETIN 371

CORNELL UNIVERSITY

AGRICULTURAL EXPERIMENT STATION OF THE
NEW YORK STATE COLLEGE OF AGRICULTURE

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THE LEAF BLOTCH OF HORSE-CHESTNUT

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PUBLISHED BY THE UNIVERSITY
ITHACA, NEW YORK

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AGRICULTURAL EXPERIMENT STATION

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LEAF BLOTCH OF HORSE-CHESTNUT



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THE LEAF BLOTCH DISEASE OF HORSE-CHESTNUT

V. B. STEWART

The horse-chestnut (*Æsculus hippocastanum*) is common throughout the State of New York. In public parks and private plantings the large, magnificent trees, with their deep green foliage, are particularly attractive. Ordinarily they are not considered desirable for street trees, however, owing to the excessive water supply that they demand; but in certain localities they have been used extensively for street planting, and in many cities the species is very prevalent.

There is some objection to the horse-chestnut because of the frequent yellowing and dying of the foliage during the summer. On trees that have received but little attention, the foliage is in many cases so dense that the inner leaves die and fall to the ground for lack of sunshine. It is believed, however, that a large proportion of the yellowing and subsequent death of the foliage may be attributed to leaf blotch, which is the most important disease affecting the horse-chestnut (*Æsculus hippocastanum*) and the Ohio buckeye (*Æ. glabra*).

Leaf blotch is known in America and in Europe, apparently occurring, to some extent at least, wherever the horse-chestnut or allied species are found. It is not observed so commonly in northern Europe as in southern Europe, and apparently is never so destructive in these regions as in America. In the eastern part of the United States, where the horse-chestnut has a wide distribution, the disease is frequently observed, and in many cases a large proportion of the foliage on mature trees is affected.

In nursery plantings leaf blotch is particularly destructive. In many cases the seedlings are completely defoliated by midsummer, and as a consequence their growth is greatly retarded. When the disease has once become established in a block of young nursery trees it usually causes considerable damage each year. The affected trees develop more slowly than they would normally, and a longer period of time is therefore required for them to attain a marketable size. Several plantings from seed have been observed which had made practically no increase in size for three seasons, due to the abundant occurrence of the leaf blotch disease each year.

Not only does premature defoliation check the growth of the young trees, but apparently the trees affected are less able to withstand the adverse conditions of the subsequent winter months. An injury and dying back of the twigs and branches has been observed on trees that were badly diseased the preceding summer.

The plantings of horse-chestnut in the nurseries of the State are relatively large, owing to the persistent annual demand for this stock. As a rule, however, nurserymen have not been successful in propagating the trees from seed because of the severe injury to the foliage caused by leaf blotch. This failure has resulted in annual importations of horse-chestnut trees from foreign countries. The trees obtained from Europe are three or four years old. They are planted in the nurseries of this country, where they are allowed to grow for one or two years longer before they are placed on the market. This method naturally involves considerable expense, requiring the nurserymen to charge a higher price for their stock than for trees successfully grown from seed in this country. Without question horse-chestnut trees protected from the leaf blotch disease can be propagated from seed at a much lower cost than that paid for imported stock.

SYMPTOMS

The leaves, and occasionally the petioles, are affected. The writer has observed lesions also on immature fruits, which were undoubtedly another type of the leaf blotch disease.

The first indication of the disease on the foliage is a slight discoloration. As the lesion increases in size it becomes more or less irregular in outline and the newly invaded tissues appear water-soaked. Gradually the central part of the lesion becomes from dark red to brown in color, while the margin shows a yellowish discoloration blending into the green of the healthy tissue. The discolored area finally becomes dried and dies. The spots may be small, or they may involve a large part of the leaf surface and thus cause the dead area to curl (see frontispiece). Minute black specks may generally be seen, scattered separately over the lesion, and in some cases these appear before the tissue is completely dried out. In many cases these specks are crowded together in a definite area, which may be slightly lighter in color than the remainder of the affected tissue.

The lesions on the petioles appear in the form of small reddish brown spots, which are usually somewhat longer than wide and extend up and down the petiole. The effects of the disease on the petiole are never very serious.

The spots on the fruit are similar to those on the petioles, but there is no decay of the fruit tissue.

The striking symptom of the leaf blotch disease, however, is the dark red or brown color of the lesions, which often involve large areas or even the entire leaf. When the disease is very prevalent, especially in nursery plantings, the foliage appears as if it had been burned over by fire.

CAUSE OF THE DISEASE

Leaf blotch is caused by a fungous pathogene, *Guignardia Æsculi* (Peck) Stewart. This parasite obtains its food and nourishment by means of minute vegetative, root-like strands, called mycelium, which penetrate the leaves of the horse-chestnut and kill the tissues invaded.

LIFE HISTORY

With the presence of the fungus in the leaf, the mycelium extends in all directions and kills the surrounding tissues, producing the characteristic leaf blotch lesions. Soon gnarls of the mycelial threads appear at various points near the upper surface of the leaf, and these result in the formation of fruiting bodies of the fungus. These fruiting bodies are known as pycnidia (Fig. 85), and are the characteristic minute specks already mentioned as appearing on the upper surface of the affected area.

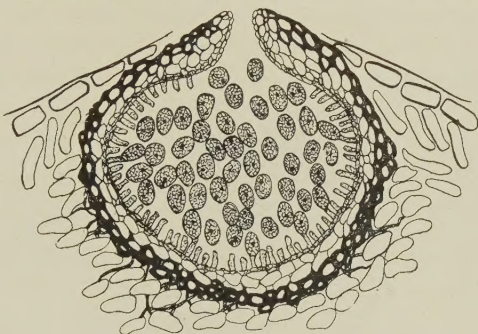


FIG. 85. CROSS SECTION OF A HORSE-CHESTNUT LEAF THROUGH A PYCNIDIUM OF THE FUNGUS (MUCH MAGNIFIED)

The spores are shown inside the pycnidium. They escape through the opening in the top

Within the pycnidium are borne a large number of spores, which are extruded from the opening in the top of the pycnidium. The spores, being very minute, are easily carried to other leaves by wind and



FIG. 86. SPORE FORMS OF THE LEAF BLOTCH FUNGUS

A, pycnosporos, some of which have germinated; B, ascus, containing eight ascospores; C, ascospores, some of which have germinated

rain, and are thus disseminated to a considerable distance. Falling on a leaf, the spore germinates, if moisture is present, by sending out a slender germ tube (Fig. 86, A), which grows into the tissue of the leaf and develops a mycelium with many branches, causing a disorganization and killing of the tissue in the affected area. When a number of spores infect the same leaf, a large part or all of the tissue becomes affected and the leaf is no longer able to function in the manufacture of food for the tree.

As the season advances the disease becomes more prevalent with each period of wet weather, and, on nursery trees especially, a large part of the foliage may be killed by midsummer. The fungus lives over winter in the old diseased leaves that fall to the ground. During the winter there are formed on these fallen leaves special fruiting bodies, known as perithecia (Fig. 87), which become mature about the time when the trees develop the first new leaves in the spring. Within the perithecium are numerous sac-like bodies, known as asci (Fig. 86, B), containing spores which escape through the opening in the top of the perithecium. These ascospores (Fig. 86, c), being very minute, are carried by the wind or by spattering drops of rain to the new foliage, where they produce the first infections of the year. From ten to fifteen days later the

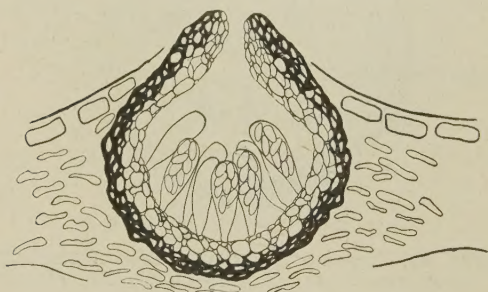


FIG. 87. CROSS SECTION OF A HORSE-CHESTNUT LEAF THROUGH A PERITHECIUM (MUCH MAGNIFIED)

The drawing shows the sac-like bodies (asci) with ascospores. In early spring the spores escape through the opening in the top of the perithecium

characteristic leaf blotch lesions begin to appear, and soon pycnidia are formed which are a source of further distribution of the fungus.

Small trees in the nursery, on which the foliage is near the ground, often show numerous spots early in the spring. This is due to the fact that a large proportion of the spores of the winter stage (perithecia) are able to reach the newly developed leaves and produce infections during

periods of damp, cloudy weather. In mature trees the chances that the spores may reach the newly developed foliage from the perithecia in old leaves on the ground are usually limited, but at least a few leaves generally become infected in this manner, and the pycnidia with spores, which develop in the lesions, are the source of new infections whenever conditions are favorable. When there is but little rainfall throughout the summer, very few spores find suitable conditions for germination and thus but little of the foliage is attacked. For this reason the disease may be more prevalent in certain years than in others.

CONTROL

In determining control methods for a fungous disease it is necessary to consider the relation existing between the host and the parasite that causes the disease. In general, in the case of leaf blotch of horse-chestnut, weather conditions that influence the trees affect also, to some extent,

the activities of the fungus. Rainy periods throughout the summer favor the growth of the trees, since sufficient moisture is supplied for their development. On the other hand, wet weather also affords the necessary conditions for the pathogene. With the presence of moisture the fungus spores are able to germinate and produce infections when they fall on the leaves of the trees. For the control of the leaf blotch disease, therefore, it is necessary to check the attack before suitable conditions



FIG. 88. A HAND DUSTING MACHINE

This duster is suitable for dusting small trees

are afforded for the germination of the spores on healthy foliage. It is impossible to check the activities of the parasite in the affected leaf after the spores have germinated and the germ tubes have gained an entrance into the leaf tissue.

As previously stated, the first infections in the spring are produced by spores from the perithecia in old dead leaves on the ground. Undoubtedly much damage can be prevented by plowing under or burning the old leaves before the new foliage is developed. A large proportion

of the perithecia are thus destroyed and the source of early infections is to a considerable extent eliminated. On the other hand, this treatment is not sufficient to completely control the disease, for usually enough old leaves remain scattered about to enable the fungus to gain a foothold on the new leaves.

In order to forestall these attacks of the fungus and subsequent infections by spores from the pycnidia, the leaf surface must be covered with a fungicide that is poisonous to the parasite. When the spore germinates, the germ tube comes in contact with the fungicide and is



FIG. 89. A POWER DUSTING OUTFIT

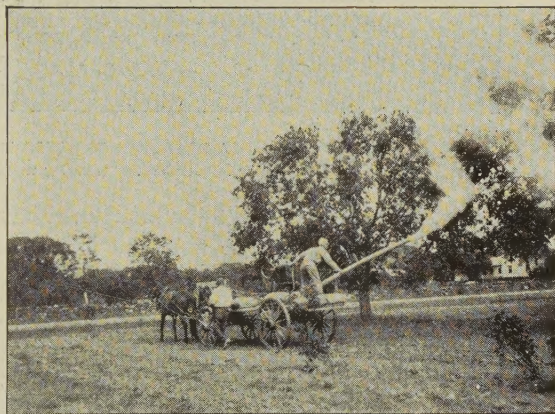
This machine is suitable for dusting large trees

killed, and thus its entrance into the tissues of the leaf is prevented. The fungicide does not penetrate the leaf and kill the mycelium, and since the spores are very minute—being about $\frac{1}{2500}$ of an inch in diameter—the fungicide must be applied so that it completely covers all parts of the leaves. The applications must be made at such intervals as will afford the greatest amount of protection throughout the summer. The proper time for the first application, especially for nursery stock, is soon after the buds open in the spring. This should be followed by at least two other treatments, made at intervals of from two to three weeks. In rainy seasons it is advisable in many cases to make one or

two additional applications in order that the foliage will be thoroughly covered with the fungicide at all times.

Lime-sulfur solution (one gallon to fifty gallons of water) or bordeaux mixture may be used for controlling the disease. Considerable difficulty has been experienced, however, in the use of these spraying mixtures owing to the dense foliage of horse-chestnut trees. In the attempt to cover thoroughly all parts of the foliage, the trees are often drenched with the spray solution, and when lime-sulfur solution is used severe burning of the leaves may result.

In the summer of 1915 an experiment was made on nursery trees for the control of leaf blotch by dusting. The dust mixture used contained ninety parts of finely ground sulfur¹ and ten parts of powdered arsenate of lead.² This mixture proved as effective as lime-sulfur solution in controlling the disease. On trees that were not treated, practically fifty-nine per cent of the leaves were diseased; while only three per cent of the leaves on the trees that were dusted showed infections, and the trees sprayed with lime-sulfur solution 1-50 had ten per cent of the foliage diseased.



PHOTOGRAPH BY F. H. POUGH

FIG. 90. DUSTING SHADE TREES

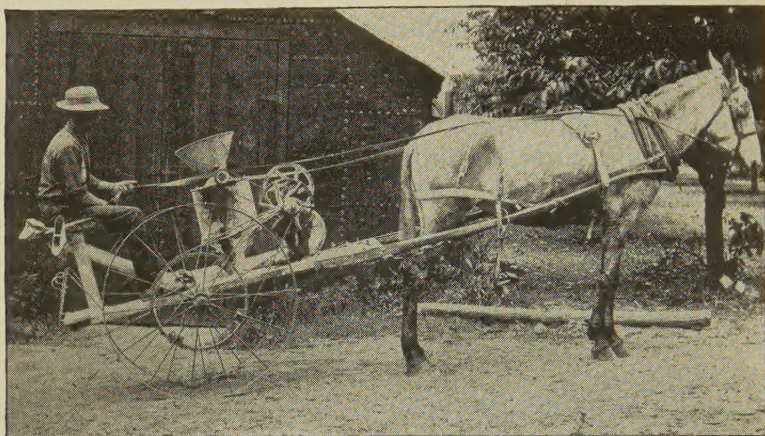
In comparing the results on the sprayed and the dusted trees, it is believed the lime-sulfur spray was the less effective mainly because of the density of the foliage. The spray was applied with a hand sprayer which lacked sufficient power to furnish the driving spray necessary to thoroughly cover all parts of the foliage, while, on the other hand, the cloud of finely ground dust mixture floated through the trees and settled on the leaves, completely covering them and thus affording better protection.

The dust mixture was applied with a hand machine, illustrated in figure 88. This duster is very satisfactory for treating small shade

¹ The sulfur was so finely ground that at least 95 per cent would pass through a 200-mesh sieve. The method of testing sulfur is described by F. M. Blodgett in Bulletin 328 of this experiment station.

² The lead arsenate was added primarily for its adhesive properties. On being moistened there is a tendency for it to become somewhat gelatinous and sticky, and this increases the adhesiveness of the mixture. Lead arsenate is effective also in controlling insects that chew the foliage. In the case of horse-chestnuts, however, which are seldom attacked by insects, finely ground gypsum, a much less expensive substance, may be substituted for lead arsenate.

trees or for use in small plantings of nursery stock. For dusting on a more extensive scale a power machine, such as is illustrated in figures



PHOTOGRAPH BY F. M. BLODGETT

FIG. 91. A TRACTION DUSTING MACHINE

This duster is suitable for treating nursery stock

89 and 90, is preferable. The outfit shown has been used successfully for dusting orchard trees. The machine is operated by a gasoline engine, and the cloud of dust mixture, which is discharged from the long pipe,



PHOTOGRAPH BY F. M. BLODGETT

FIG. 92. TRACTION DUSTING MACHINE IN OPERATION

floats through the trees and completely covers all the foliage. The machine is suitable also for dusting shade or park trees.

For treating large plantings of horse-chestnut trees in the nursery, a traction duster such as is illustrated in figures 91 and 92 is desirable. The machine is especially light in weight and runs between the rows, the dust being discharged from the two pipes in the rear. One man and a horse are all that is required to operate this machine.

Although spraying is effective in controlling leaf blotch, the dust method is preferable, as there is less danger of injuring the foliage by burning; further, the dust mixture can be applied more thoroughly and with greater facility than the spraying solution. The dust mixture is somewhat more expensive than the spraying solution, but its greater cost is offset by the consequent saving in time and labor.

